

SCENARIO PLANNING

*DEVELOPING AND IMPLEMENTING SCENARIOS FOR YOUR
INTEGRATED RESOURCE PLAN*

Horizons Energy

Indiana Contemporary Issues Conference
April 25, 2017



AGENDA

- **Why Scenario Analysis is Important**
- Developing Scenarios (Qualitative)
 - Scenario Building Blocks
 - Themes
 - Story Lines
 - Timelines
- Implementing Scenarios (Quantitative)
 - National Level IRP
 - Utility Level IRP

Why Scenario Analysis Is Important

**Challenge the
status quo**

“If past history was all there was to the game, the richest people would be librarians.”

Warren Buffett

**Anticipate the
unexpected!**

“A failure of imagination. We failed to imagine that the era we now find ourselves in could ever happen.”

Thomas Kean, Chair, 9/11 Commission, July 23, 2004

**Consistently
assess business
decisions**

“We are continually faced by great opportunities brilliantly disguised as insoluble problems.”

Lee Iacocca

Defining Uncertainty

“As we know, there are known knowns; there are things we know we know.

We also know there are known unknowns; that is to say we know there are some things we do not know.

But there are also unknown unknowns—the ones we don’t know we don’t know.”

Donald Rumsfeld

United States Secretary of Defense, February 12, 2002

Rumsfeld was referring to the Department of Defense use of a Johari Window

Johari Window

| | KNOWN | UNKNOWN |
|---------|--|--|
| KNOWN | <p>“As we know, there are known knowns; there are things we know we know.”</p> | <p>An unknown known is something we know, but do not realize is relevant.</p> |
| UNKNOWN | <p>“We also know there are known unknowns; that is to say we know there are some things we do not know.”</p> | <p>“But there are also unknown unknowns - the ones we don’t know we don’t know.”</p> |

Black Swan Event (Unknown, Unknown)

Unexpected events of large magnitude and consequence. Such events, considered extreme outliers, collectively play vastly larger roles than regular occurrences.

While Black Swans are unpredictable by definition (unknown, unknown), we still can perhaps study their impacts. In other words, we may not know the cause, but we can guess possible impacts to the utility industry input drivers.

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Scenario Building Blocks

- **Time Horizon** – Generally 20 or more years
- **Predetermined Elements** – Legal, Market, or Societal Forces (microgrids, market competition, reliability)
- **Key Uncertainties** – Forces driving fundamental changes (renewables, batteries, natural gas, environmental concerns)
- **Prime Movers** – Intuitions and actors that can directly affect Key Uncertainties (President, Congress, EPA, FERC, IURC, State Governments, RTOs)
- **Wildcards** – High-impact very low probability events (i.e. Black Swan Events)
- **Signposts** – Specific future events that may signal or verify the existence of a scenario

Themes

The scenario building blocks are organized into themes. The idea is to create unique plausible futures based on a theme.

The themes could be around Technology, Reliability, Globalism, Isolationism, Terrorism, Green World, etc.

The goal is to create diverse themes which “bookend” a wide variety of plausible futures. It’s important to avoid the tunnel vision and herd mentality of the day when creating the themes.

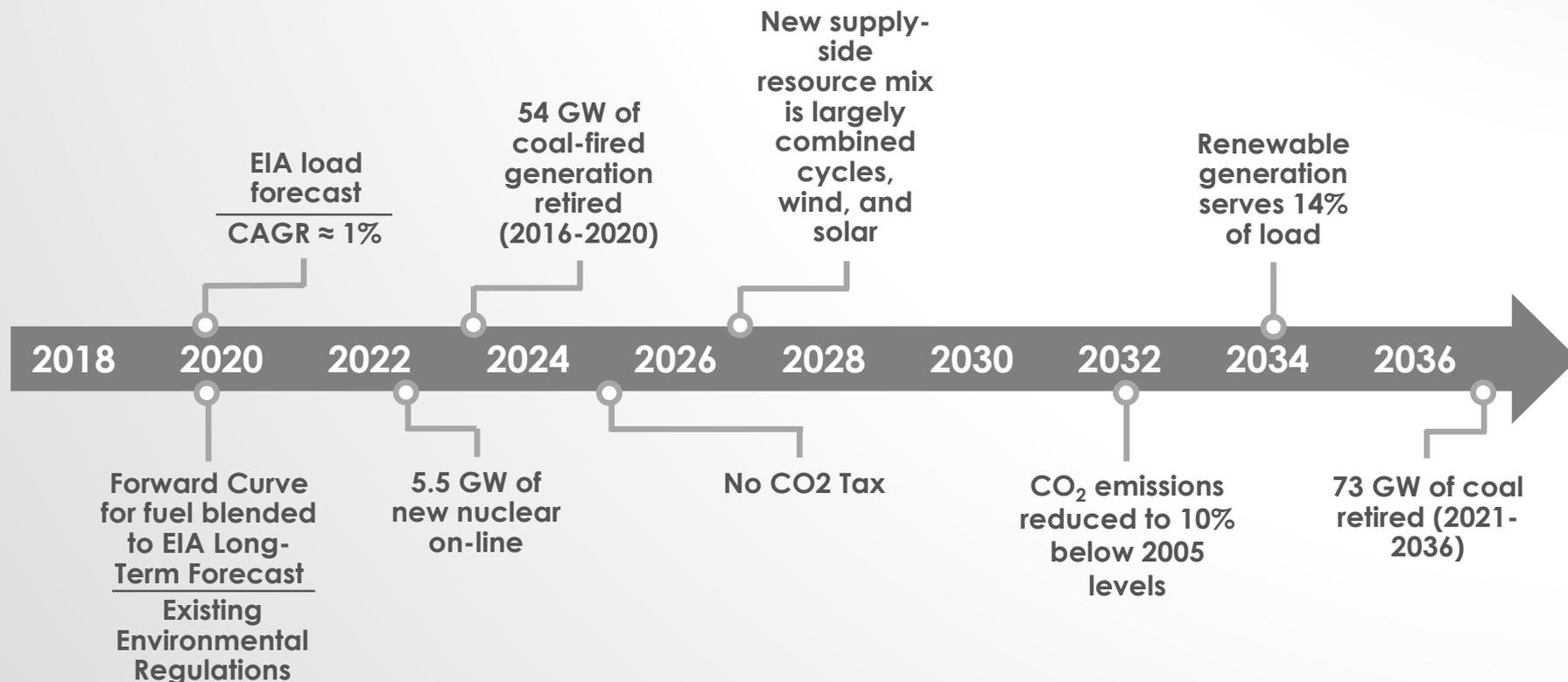
Storylines

A Storyline is developed for each Scenario Theme. In this exercise, the stakeholders identify events which are expected to occur in this scenario including their impact and timing.

The idea is to create a narrative around each plausible future by identifying signposts which may indicate the pace and direction of that particular scenario.

Developing Timelines

A Timeline is developed for each Storyline. The timeline provides the necessary information to model the scenario.



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Scenario Drivers

| | Status Quo | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 |
|---------------------------|------------------------|------------------------|-----------------------------|-----------------------------|--|
| Demand | Reference | Low | Medium-Low | Medium-High | High |
| Fuel | Reference | Low | Medium-High | Medium-Low | High |
| Technology Improvements | Current | Current | Battery, smart grid, EE, EV | Battery, smart grid, EE, EV | Advanced battery, smart grid with fed incentives |
| Environmental Regulations | Existing Laws | Existing Laws | CO2 Cap and Trade | CO2 Tax | CO2 Rate Cap |
| Reserve Margin | Pool Requirements + 1% | Pool Requirements + 2% | Pool Requirements | Pool Requirements + 2% | Pool Requirements + 3% |

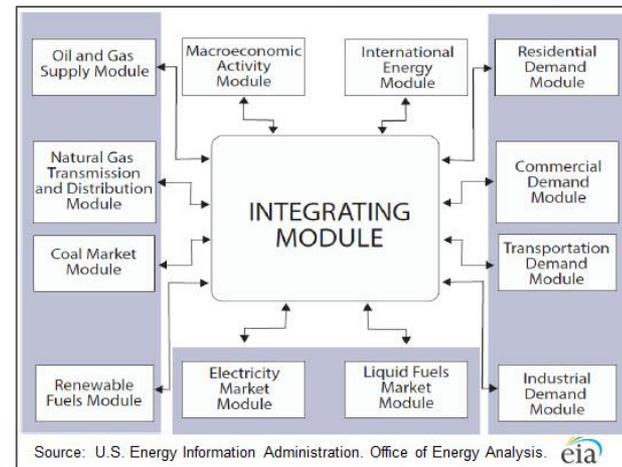
Market Simulation (National IRP)

Data

Fundamental Data Sources

- EIA 860
- EIA 923
- FERC 714
- EPA NEEDS
- EIA NEMS
- NYMEX
- NREL
- Horizons Energy Research

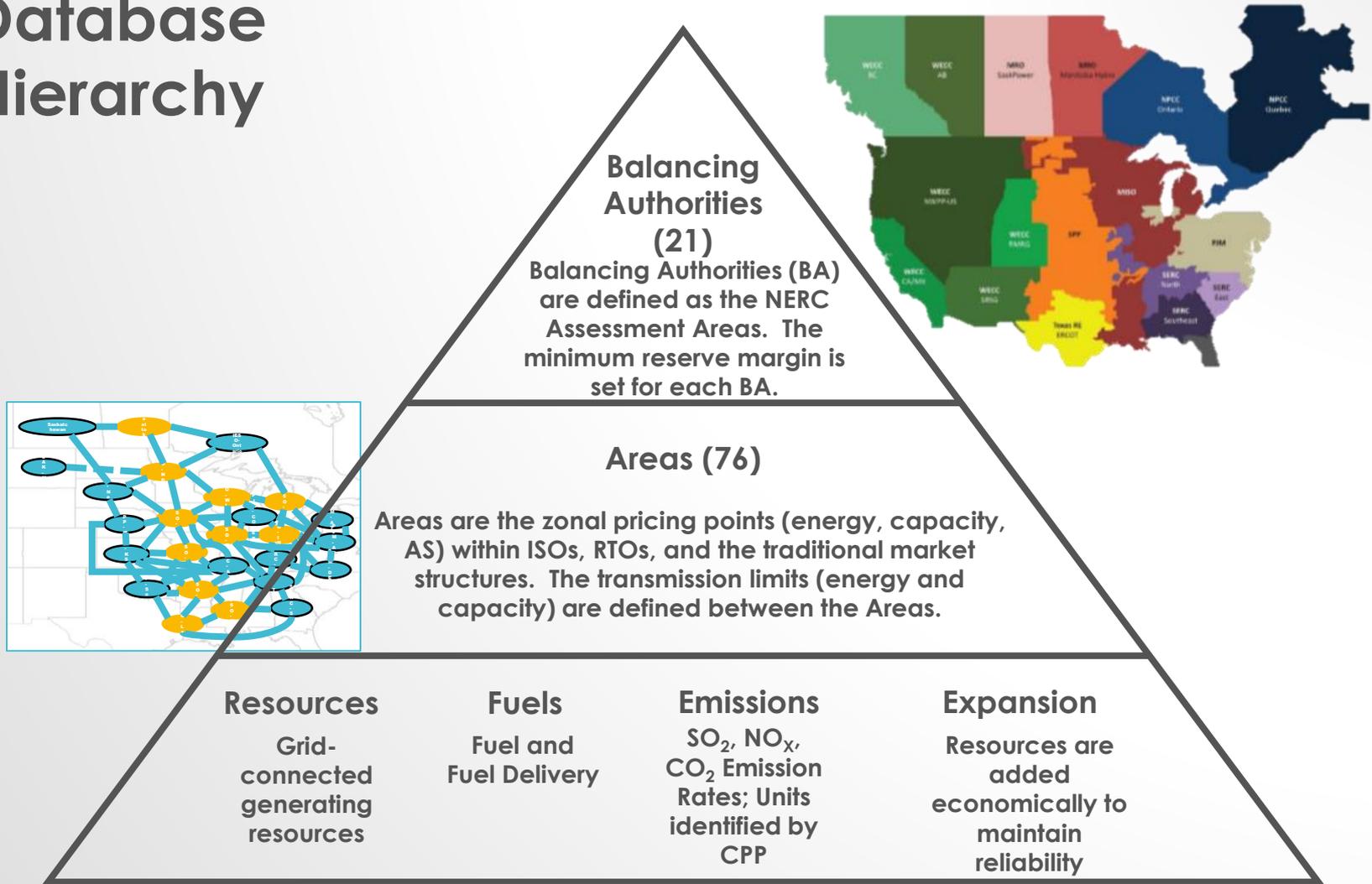
EIA NEMS Model



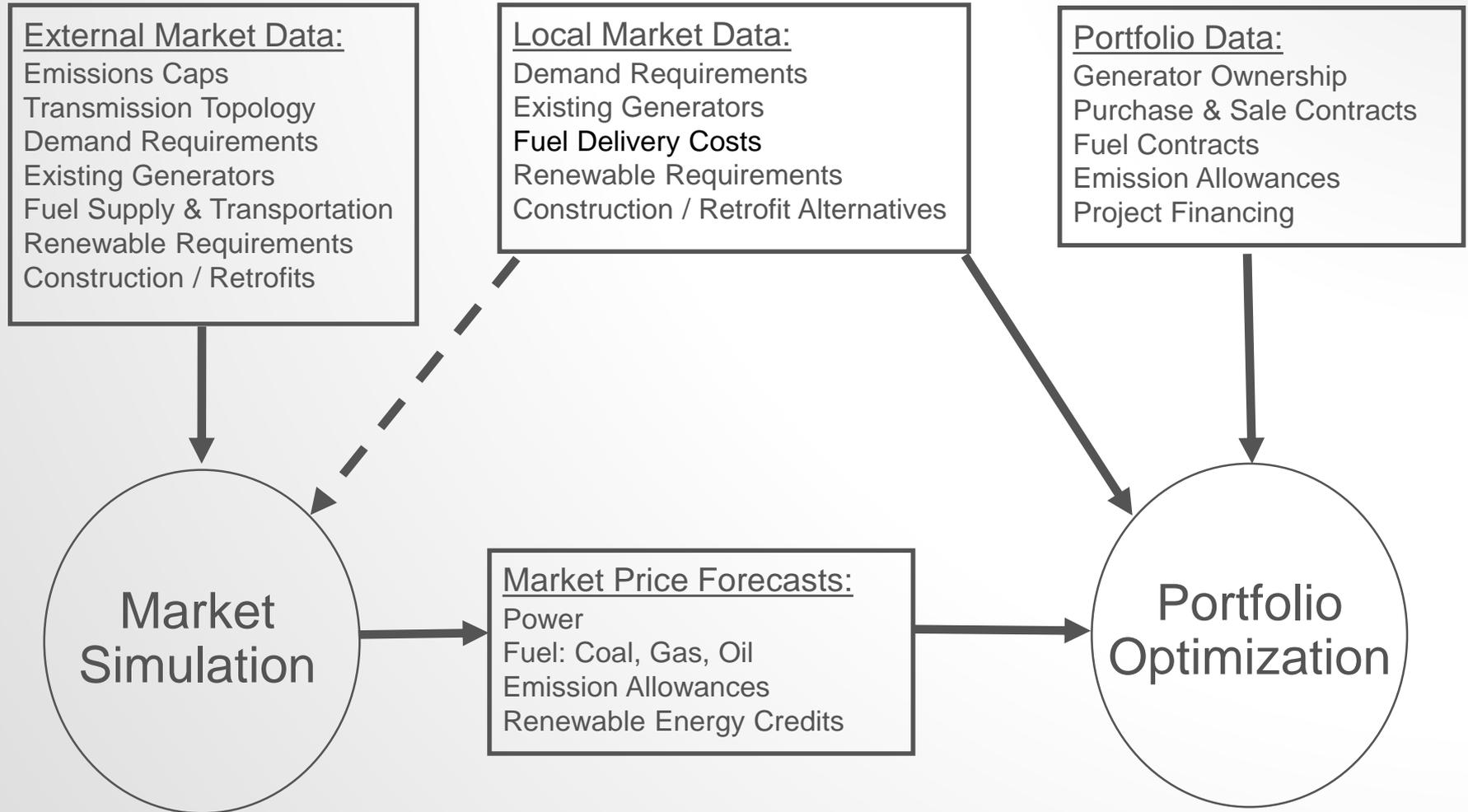
Integrated Market Model

- Energy Prices
- Capacity Prices
- Ancillary Services Prices
- Emissions Prices
- Fuel Prices
- REC Prices
- Capacity Additions
- Capacity Retirements

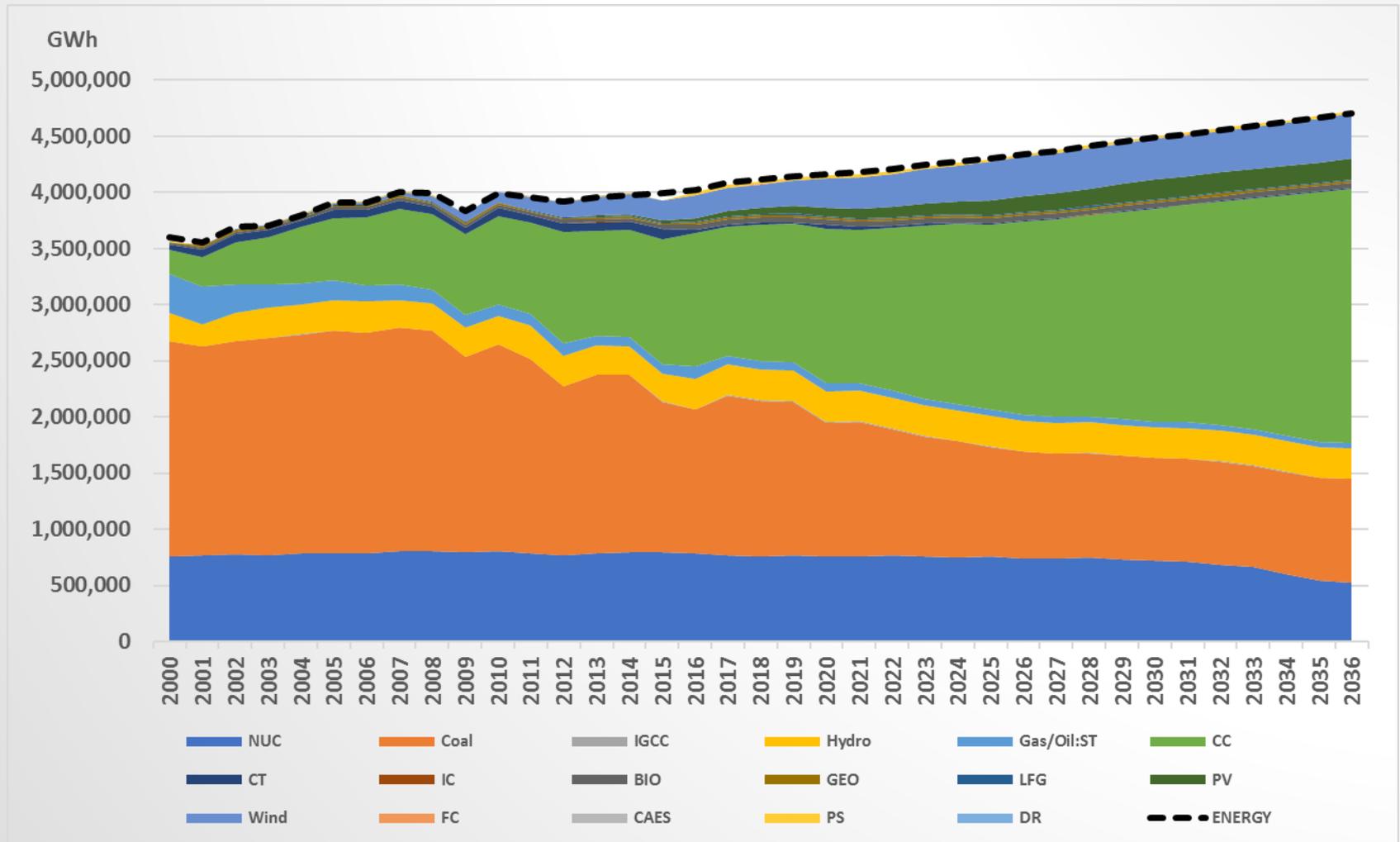
National Database Hierarchy



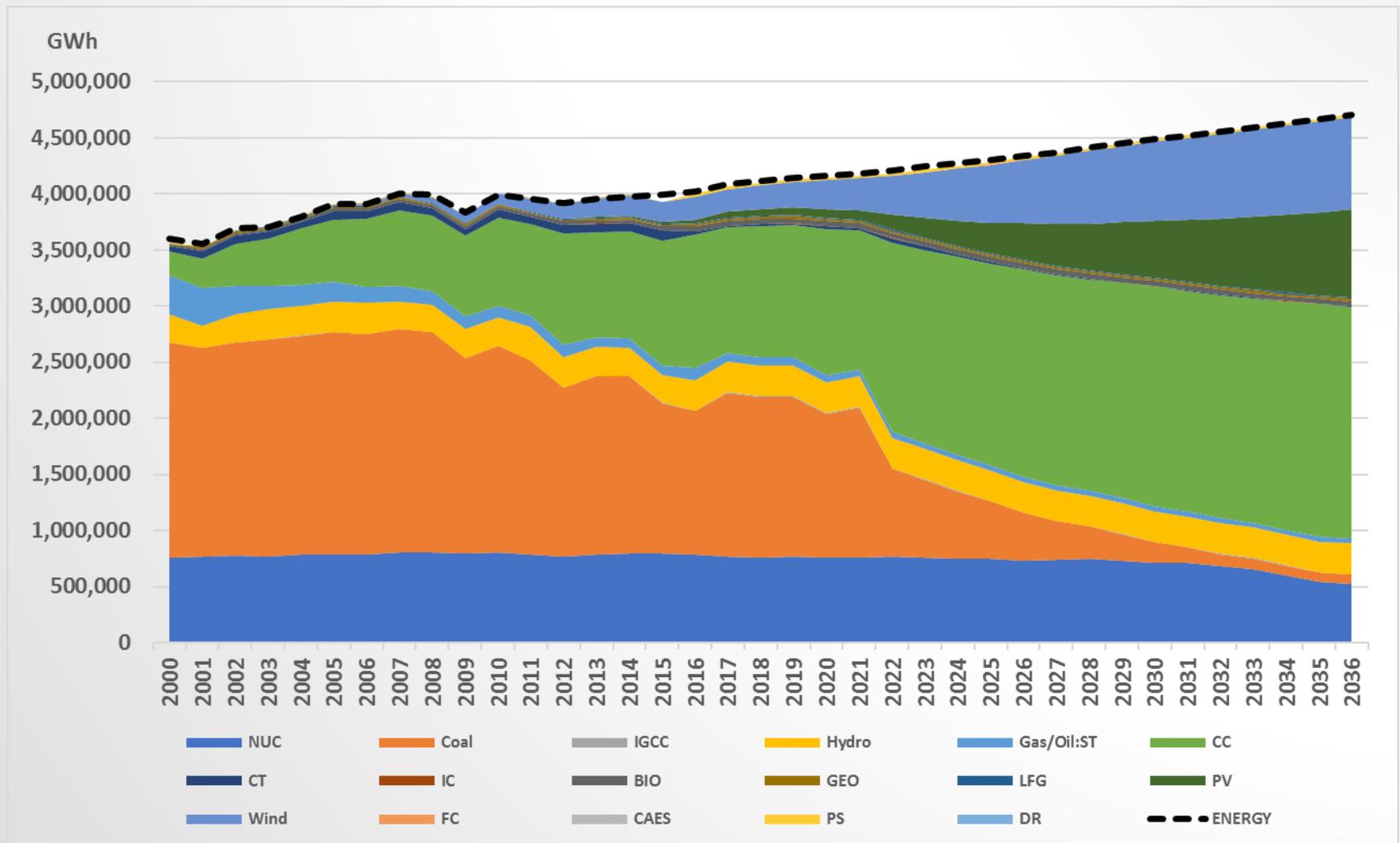
From Scenarios to Strategy



National IRP – Status Quo



National IRP – Scenario 5



The Portfolio Hand-Off

Proceed with caution.

The input driver assumptions (fuel prices, load, policy, etc.) and the output results (energy prices, capacity prices, emission prices, allowance prices, A/S prices, etc.) are then passed to the Utility's portfolio model for detailed optimization.

Be sure all of the inputs and outputs are consistent between the market model and portfolio model including time-of-day data.



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